

# Change in Name and Status of a Pampas Grass (*Cortaderia*, Poaceae: Arundinoideae) from Bolivia

Mark Lyle

Forschungsinstitut Senckenberg, Senckenberganlage 25, 60325 Frankfurt am Main, Germany

**ABSTRACT.** Based on distinct morphological and anatomical characteristics, *Cortaderia bifida* var. *grandiflora* Henrard, currently considered a synonym of *C. bifida* Pilger, is raised to specific status as *Cortaderia boliviensis*. Known only from the Bolivian Andes, its distribution, ecology, and phenology are briefly discussed.

**RESUMEN.** En base a sus características morfológicas y anatómicas distintas, *Cortaderia bifida* var. *grandiflora* Henrard, considerada actualmente como un sinónimo de *C. bifida* Pilger, es elevada al rango de especie como *Cortaderia boliviensis*. Se discute brevemente la distribución, ecología y fenología de esta especie conocida solamente de los Andes bolivianos.

The genus *Cortaderia* Stapf includes 17 species distributed throughout South America and five species found in New Zealand. *Cortaderia selleana* (Schultes) Ascherson & Graebner, the type species, is a well-known ornamental grass. Four sections are described by Conert (1961). Two of these sections occur in Bolivia: the species of section *Cortaderia* have long, awnless, linear lemmas; those of section *Bifida* have lemmas awned between two lateral lobes. Fieldwork in the Murillo and Yungas provinces of Bolivia provided material clearly showing that *Cortaderia bifida* var. *grandiflora* of section *Bifida*, previously considered a synonym of *C. bifida* (Conert, 1961; Connor & Edgar, 1974; Connor, 1983), should be given specific status.

## ***Cortaderia boliviensis*** Lyle, nom. et stat. nov.

Based on: *Cortaderia bifida* Pilger var. *grandiflora* Henrard, Meded. Rijks Herb. 40: 67. 1921. TYPE: Bolivia. Departamento Cochabamba: "Charaktergras der Andenwiesen über Tablas, feuchte Stellen, 3400 m, Mai 1911," Herzog 2194 (holotype, L; isotypes, L, S, US, W). Figures 1, 2.

Caespitose, perennial grass forming large, dense tussocks. Basal leaves; blades coarse, erect to lax; senescent sheaths and basal cm of leaves curling tightly at tussock base, persistent. Culms 30–150

cm tall, slightly erect to spreading, unbranched, stiff, hirsute, with several attenuate, glabrous nodes. Sheaths of culms longer than internodes; lower sheaths tightly enclosing culm, glabrous, light brown to light straw-colored with purple hue, margins whitish; uppermost culm sheath light straw-colored, usually  $\pm$  widely open at base of panicle and loosely appressed to it. Ligule a very dense, often three-pointed rim of  $\pm$  2 mm long, white hairs, some running a few mm down edges of blade. Leaf blades slender-linear, tapering off to fine point, light green to yellowish, edges and midrib of upper half with prickle hairs, longitudinally twisted to reveal abaxial leaf surface upward. Basal leaves (20–) 60–90(–130) cm long, culm leaves to 30 cm long, 2.5–6 mm wide. Panicle 10–25(–35) cm long, 5–10 cm wide, terminal, richly branched, oblong, lax, leaning to one side, seldom  $\pm$  erect, light brown, glossy. Main axis round, shortly scabrous, light brown. Panicle branches spreading  $\pm$  erectly from main axis in distichously arranged bunches, shortly scabrous, light brown, lowest to 15 cm long. Spikelet branches 2–8 mm long, light brown, angular, shortly scabrous.

*Female plants.* Spikelets 2–3(–4)-flowered, with one reduced floret above, 10–11 mm long without awn, laterally compressed, light golden-brown to straw-colored, glossy, opening at anthesis, disarticulating above persistent glumes and between florets at maturity. Glumes  $\pm$  equal or lower slightly shorter, 7–11 mm long, 1–1.2 mm wide, 1(–3)-nerved, linear-lanceolate, acute, light golden-brown, occasionally base with purple hue, hyaline, glossy. Callus slender, narrow-rounded, 1.3–1.5 mm long, very densely covered with up to 2 mm long, white hairs. Rachilla internodes  $\pm$  1 mm in length, thin, glabrous. Lemma 3(–5)-nerved, 3–4 mm long to attachment point of awn, 1.5–2 mm wide with continuous central nerve and lateral nerves terminating in lemma or lateral lemma lobes, linear-lanceolate, membranous, light brown to whitish with purple hue, hirsute, shortly ciliate along apex and margins, basal 2 mm of dorsal side densely covered with 4–5 mm long, spreading, glossy, white hairs, awned between two (0.5–)1.5–

3(–5) mm long, setiform, scabrously ciliate lateral lobes, seldom a further 0.5–1 mm long, ciliate lobe on outer rim of lateral lobes. Awn 8–11 mm long, light brown, shortly scabrous, basal part flattened and joined to inner margins of lobes, loosely twisted. Palea bicarinate, 5 mm long, 0.8–1 mm wide, lanceolate, apex truncate to biacutus, membranous, hirsute, densely ciliate on keels and margins, sparsely hairy on flanks. Lodicules 0.5–1 mm long with several 0.5–1 mm long hairs along upper edge. Staminodes 0.2–0.3 mm long, roundish, reduced and non-functional. Ovary  $\pm$  1.2–1.7 mm long, oblong-elliptic, apex biacutus. Caryopsis 2–3 mm long.

*Transverse leaf section.* Leaf blade W-shaped, with prominent midrib and symmetrical halves. Midrib always a single median vascular bundle, conspicuously displaced from blade halves through wide abaxial and deep adaxial furrows, lying deeper than adjoining vascular bundles that usually are also displaced through furrows. Ribs above all vascular bundles rectangular, flattened. Adaxial and abaxial rib of median vascular bundle often pointed roof-like. Furrows narrow,  $\frac{1}{3}$ – $\frac{1}{2}$  height of leaf transect. Abaxial surface smooth, only midrib and 1(–2) neighboring vascular bundles with shallow intercostal furrows. Costal epidermal cells of adaxial surface small with  $\pm$  thickened outer wall, many elongated as mushroom-shaped papillae. In intercostal region single stomata and small, oval, bulliform cells in chain-like groups, only near midrib are bulliform cells enlarged, forming conspicuous, fan-shaped groups. Abaxial epidermal cells in costal and intercostal regions uniform, outer wall thickened. Vascular bundle sequence of each lamina determined by 5–12 primary and secondary vascular bundles alternating with tertiary vascular bundles. Primary vascular bundles elliptical to wide-oval. Inner bundle-sheath complete, its cells elliptic, walls extremely thickened, lumina small. Outer bundle-sheath interrupted abaxially by many collenchyma cells with large lumina, its cells  $\pm$  uniform, elliptic to round, thin-walled, larger than mesophyll cells, chloroplasts absent. Sclerenchyma girders distinctly developed above all vascular bundles. Abaxial sclerenchyma a 1(–2) layer hypodermal band, interrupted only by 2–4(–6) abaxial furrows. Abaxial epidermis and overlying band of sclerenchyma are strictly separated from vascular bundles and chlorenchyma by 2–3(–4) layers of very large, collenchymatically thickened, colorless parenchyma cells. Chlorenchyma fills entire transect, forming V-shaped group between all vascular bundles and H-shaped group near midrib vascular

bundle. Cells predominately hexagonal, regularly arranged, without intercellular spaces.

*Adaxial epidermis.* Epidermal cells of adaxial surface elongated in costal region, each drawn out in a large, round papilla. Long-cells 4–6 $\times$  longer than wide, widest at middle, pointed toward ends or truncated. From margins to center of intercostal region lie rows of epidermal cells with papillae and long-cells without papillae, between long-cells lie 2–3 rows of stomata, microhairs and bulliform cells. Long-cells 3–4 $\times$  longer than wide with thickened, sinuous walls. Stomata wide-elliptic to almost circular between short or long, star-shaped cells. Microhairs common, with very long, slender basal cell and short, slender apical cell.

*Abaxial epidermis.* Epidermal cells of abaxial surface uniform, long-cells usually 6–8 $\times$  longer than wide. Between these many short cells with thickened, undulated walls, usually  $\frac{1}{2}$  longer than wide. Single large prickly hairs along leaf margins. Short cells paired with transverse-elliptic silica-cells in single rows.

*Distribution, ecology, and phenology.* *Cortaderia boliviensis* occurs between 2400 and 4300 m on the perhumid northeastern slopes of the Bolivian Andes (Fig. 3). Above the treeline ( $\pm$  3700 m in the Murillo and Yungas provinces, where the fieldwork took place) the species is locally common in perhumid grasslands (puna), growing in extremely wet, acidic, humic soils of meadows, marshes, slope-bogs and bogs, along streams and on permanently wet rock outcrops, cliffs, and waterfalls. Below the treeline the species is restricted to naturally treeless, permanently wet rock outcrops and cliffs. Most specimens have been collected in the perhumid puna of the Unduavi and Quime valleys. Only the type and an additional specimen were collected near Cochabamba, and one specimen (*Renvoize & Cope 3833*) was collected from a semihumid puna in southeastern Bolivia. The species does not inhabit open or disturbed soils. Adult plants are susceptible to repeated burnings and grazing by cattle after fire damage has occurred. Large, abundantly flowering tussocks are found only in rocky sites, free from both. Flowering apparently occurs during the drier months from March to August. Dispersal happens only through seeds that germinate among mosses and in rock cracks. No vegetative dispersal was observed.

*Note.* Only (apomictic) female plants with abundant seed-set were found above 3500 m. Most specimens below 3500 m had already flowered before the fieldwork period. Below 3500 m, pollen-sterile plants with staminodes longer than 2 mm



Figure 1. *Cortaderia boliviensis* Lyle. —a. Habit. —b. Portion of leaf showing hairy, three-pointed ligule. —c. Glume. —d. Hairy lemma with awn and lateral lobes. —e. Palea. —f. Lodicules. g, h. Ovary, styles, and staminodes at anthesis.

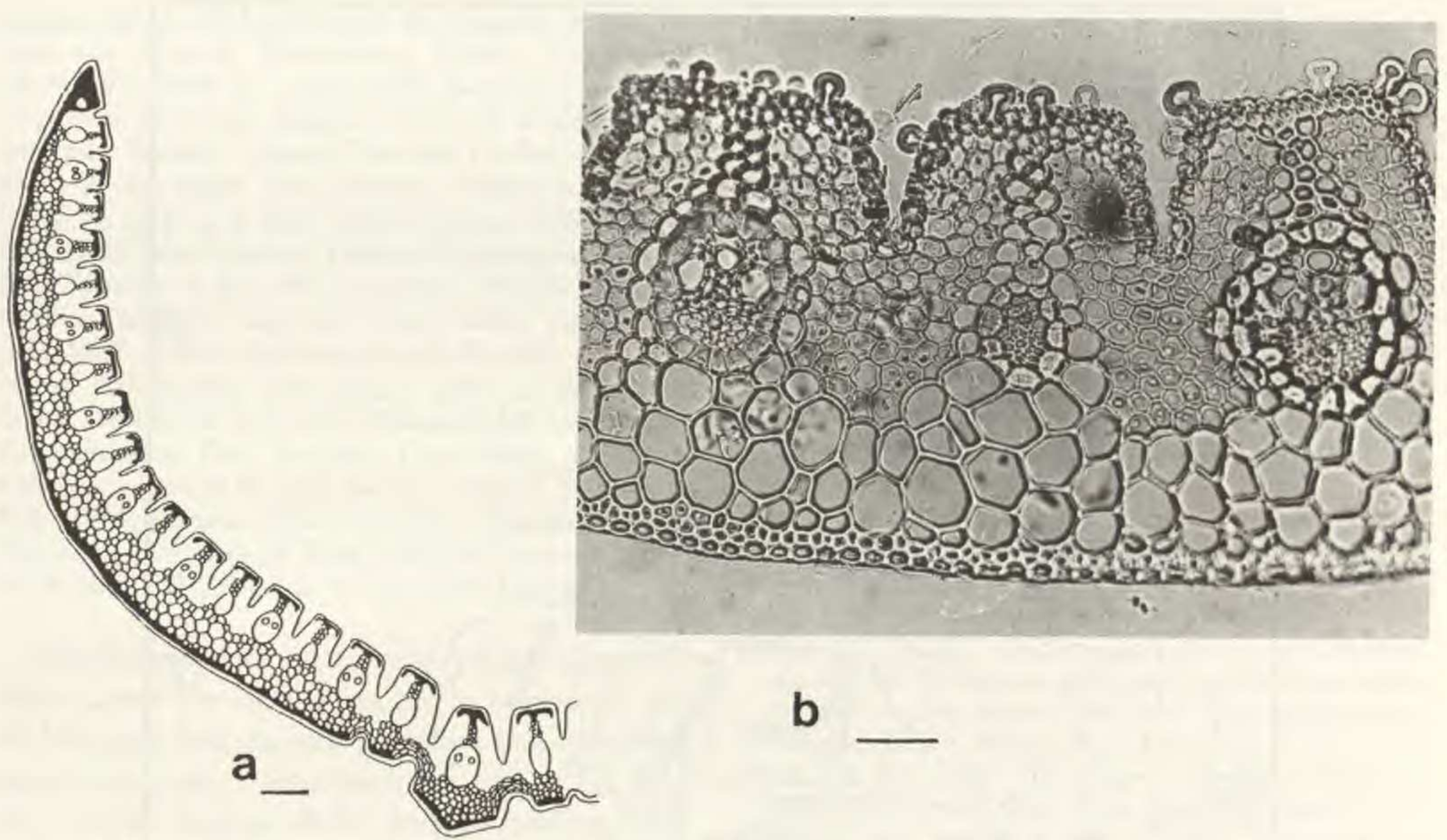


Figure 2. Transverse leaf section of *Cortaderia boliviensis* Lyle. —a. Overview. —b. Detail. Scale bars: a = 0.2 mm; b = 0.05 mm. (Based on Lyle 14 (FR).) (Drawn by M. Lyle.)

occur irregularly and make up less than 15% of all collected specimens. Pollen-fertile hermaphrodite plants can be expected, but have not yet been verified.

Because of its long lateral lemma lobes, *C. boliviensis* was originally described by Henrard (1921) as a variety of *C. bifida* and has long been mistakenly considered a synonym of the same (Hitchcock, 1927; Conert, 1961; Connor & Edgar, 1974). Both species have long lateral lobes but these differ morphologically: those of *C. bifida* run together almost to a single point at the lemma apex, where they usually separate again as awns; those of *C. boliviensis* run parallel to one another and remain separated from the awn as distinctly developed lobes. The florets of *C. bifida* are silvery white, the staminodes are large (1–1.5 mm), and the stigmas are often dark red or purple. The florets of *C. boliviensis* are golden brown or straw-colored, the staminodes are minute (0.2–0.3 mm), and the stigmas are usually yellow. The senescent sheaths of both species curl tightly at the tussock base; however, those of *C. bifida* break at the ligule whereas those of *C. boliviensis* remain attached to the plant. The leaf anatomy of both species differs as well.

The 2–4 layers of colorless parenchyma cells separating the abaxial epidermis and overlying band of sclerenchyma from the vascular bundles and chlorenchyma of *C. boliviensis* are not found in *C. bifida*, nor do the costal epidermal cells of *C. bifida* or any other *Cortaderia* species have the conspicuous mushroom-shaped papillae characteristic for *C. boliviensis*. Its distinctly different morphology and leaf anatomy clearly define it as a separate species within the genus.

Although both species grow in the same perhumid Andean environment, they differ ecologically. *Cortaderia bifida*, which is distributed in the Andes from Venezuela to Bolivia, is an aggressive weed that quickly inhabits disturbed soils. When crowded by shrubs or trees, it produces stolons of up to 7 m length, that often cascade over rock outcrops along roadsides. *Cortaderia boliviensis* is apparently endemic to Bolivia, and although it is also a pioneer on rock outcrops, it is not found on open or disturbed soils and it does not produce stolons.

*Additional specimens examined.* BOLIVIA. **La Paz:** Prope La Paz, circa alt. 3600 m, 1906, *Hauthal 338* (♀) (GOET); Prov. Murillo, bajando la cumbre 13 km hacia Unduavi, 3850–3950 m, *Ladura escarpada de gramineas*

←  
—g. Female specimen. —h. Pollen-sterile, morphologically non-female sex-form. Scale bars: a = 5 cm; b = 0.5 cm; c, d, e, f, g, and h = 2 mm. (a–g based on Lyle 365 (FR); h based on Killeen 2653 (FR).) (Drawn by E. Michels.)

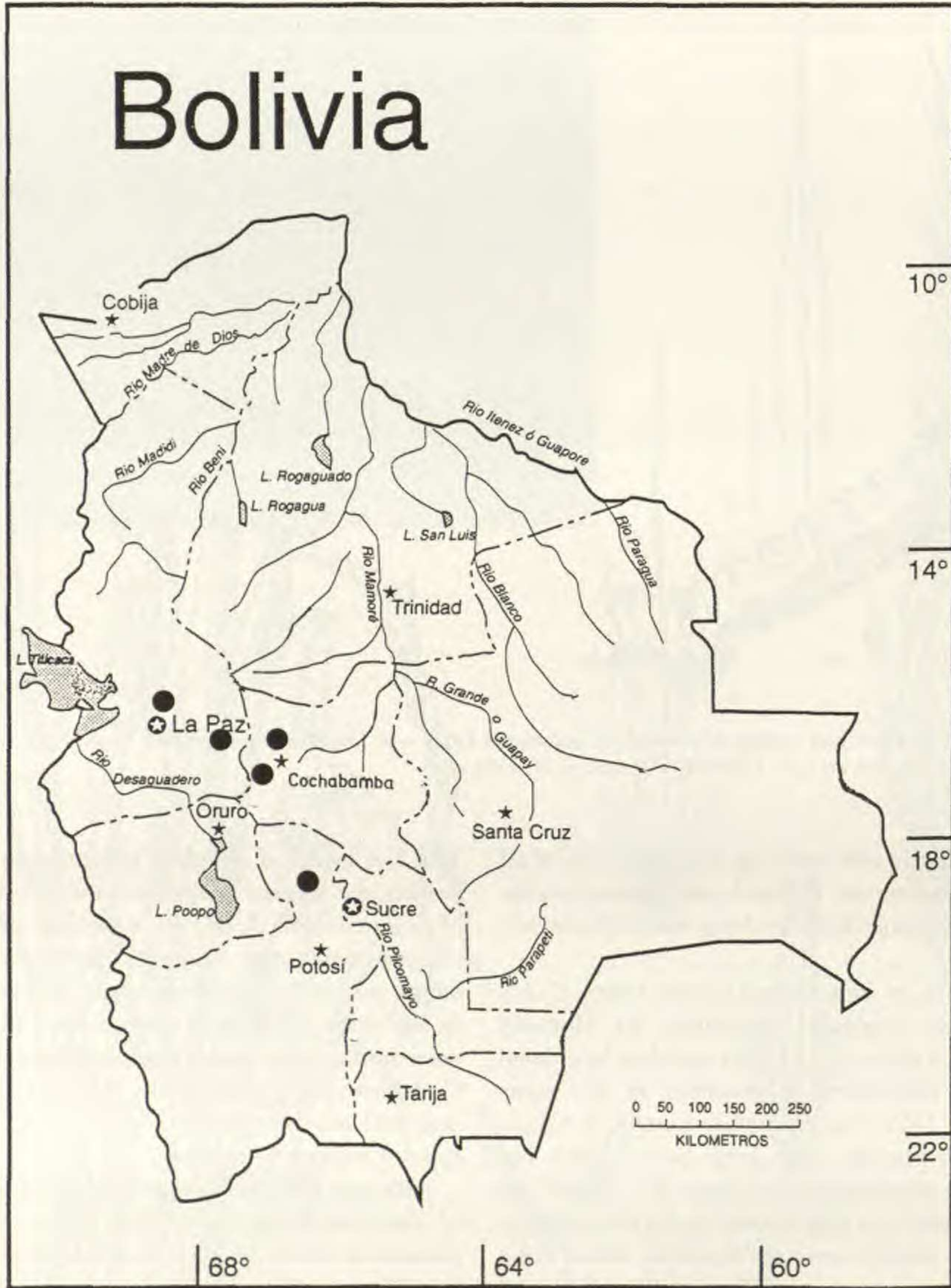


Figure 3. Distribution of *Cortaderia boliviensis* Lyle. (Map taken from Killeen et al., 1993. Used with permission.)

con afloramiento rocoso. 16 jun. 1985, Beck 11273 (♀) (K, US); Pongo, 6 km above Unduavi, E slope of small valley S of piscicola, water-saturated slate, 3900 m, 12 Oct. 1990, Lyle 10 (♀), 11 (♀), 12 (♀), 14 (♀) (FR, LPB); Pongo, 6 km above Unduavi, near Rio Choquetanga 50 m NW of road, water-saturated slate, 3700–3800 m, 03 Nov. 1990, Lyle 142 (♀), 147 (♀), 146 a (♀), 146 b (♀), 197 (♀), 198 (♀), 199 (♀), 209 (♀), 211 (♀), 212 (♀), 214 (♀), 215 (♀), 216 (♀), 219 (♀), 220 (♀), 221 (♀), 222 (♀), 223 (♀), 224 (♀), 225 (♀), 226 (♀), 228 (♀), 229 (♀), 230 (♀), 231 (♀), 232 (♀), 233 (♀) (FR, LPB); Pongo, 6 km above Unduavi, E of Rio Choquetanga NW of road, water-saturated slate, 3700–4050 m, 15 Nov. 1990, Lyle 305 (♀), 309 (♀), 310 (♀), 311 (♀), 314 (♀), 365 (♀) (FR, LPB); Pongo, 6 km above Unduavi, along Rio Choquetanga above waterfall NW of road, water-sat-

urated slate, 3700–3900 m, 17 Nov. 1990, Lyle 420 (♀) (FR); Pongo, 6 km above Unduavi, near Rio Choquetanga, 3600–4100 m, 24 Dec. 1990, Lyle 624 (♀), 625 (♀), 627 (♀) (FR, LPB); Prov. Nor Yungas, ± 3 km above Unduavi, camino ingeniero a Mina San Luis, treeline, 3400–3500 m, 06 Jan. 1991, Lyle 637 (♀), 638 (non-♀), Lyle 645 (aberrant ♂), 648 (non-♀), 649 (sterile), 650 (sterile), 660 (sterile), 662 (non-♀), 663 (sterile), 671 (non-♀), 673 (non-♀), 674 (♀), 681 (♀), 682 (♀), 689 (♀), 705 (sterile), 711 (♀, staminodes 0.9 mm) (FR, LPB); roadside between Unduavi and Chuspi Pata, cloud forest, ± 2900–3200 m, 23 Jan. 1991, Lyle 784 (sterile) (FR); rocky roadside embankments below Chuspi Pata on road leading to Yolosa and Coroico, 2900–2600 m, 23 Jan. 1991, Lyle 792 (sterile), 805 (♀), 806 (non-♀), 814 (sterile) (FR, LPB); Sendero al Río Coscapa (ca. 3 km al este Unduavi por el

camino nuevo) 5.6 km al oeste de Cotapata, bosque nuboso con *Miconia*, *Weinmannia*, *Clethra*, 16°17'S 67°53'W, 3300–3500 m, 5 mayo 1990, *Solomon et al.* 18932 (♀) (MO); Prov. Sud Yungas, 1.4 km W of Unduavi, on new road between Chuspi Pata and La Paz, low cloud forest at the upper limit of forest vegetation, 16°18'S, 67°55'W, 3400 m, 2 July, 1986, *Solomon* 15382 (♀) (K, LPB, MO); Prov. Inquisivi, Laguna Huichincana and Mina Don Vincente 9 km NW of Quime, 16°57'S, 67°17'W, 4150 m, páramo, along fast stream below waterfall, 12 Aug. 1987, *Killeen* 2653 (non-♀) (F, FR, MO, US); 4 km NE of Huayñacota, steep slopes with low bushes and herbs, 3800 m, 23 Apr. 1992, *Renvoize* 5342 (♀) (FR, K); **Cochabamba:** Prov. Tapacari, Com Rodeo, bosque de *Polylepis*, cabecera de valle, bosque montano, 3600 m, 26 Feb. 1991, *Hensen* 1146 (♀) (US). **Potosí:** Province Chayanta, 7 km south of Ocuri, cliff face above road, 3950 m, 06 Mar. 1981, *Renvoize & Cope* 3833 (♀) (K, MO, U).

*Acknowledgments.* I sincerely thank Hans-Joachim Conert for introducing me to *Cortaderia* and for his continued support, guidance, and friendship over many years. I also thank the staff at FR, Emilia Garcia, Stephan Beck, and the staff at LPB, and Steve Renvoize and the staff at K for their support. I further thank the late E. Michels for her

illustrations. Thomas Borsch and Hans-Joachim Esser helped with critical comments to the text. My appreciation also goes to the curators at F, GOET, K, L, MO, S, U, US, and W for providing loans. Financial support for herbarium work at Kew and for the fieldwork in Bolivia came from the Hermann Willkomm Foundation and the Deutsche Akademische Austauschdienst (German Academic Exchange Service).

#### Literature Cited

- Conert, H.-J. 1961. Die Systematik und Anatomie der Arundineae. J. Cramer, Weinheim.
- Connor, H. E. 1983. Names and types in *Cortaderia* Stapf (Gramineae) II. *Taxon* 32: 633–634.
- & E. Edgar. 1974. Names and types in *Cortaderia* Stapf (Gramineae). *Taxon* 23: 595–605.
- Henrard, J. T. 1921. Gramineae. Pp. 39–77 in T. Herzog, Die von Dr. Th. Herzog auf seiner zweiten Reise durch Bolivien in den Jahren 1910 und 1911 gesammelten Pflanzen. Teil V. Meded. Rijks Herb. 40: 1–77.
- Hitchcock, A. S. 1927. The grasses of Ecuador, Peru, and Bolivia. *Contr. U.S. Natl. Herb.* 24(8): 291–556.
- Killeen, T. J., E. García E. & S. G. Beck. 1993. Guía de Árboles de Bolivia. Herbario Nacional de Bolivia, La Paz & Missouri Botanical Garden, St. Louis.